Workshop 1

Data Decimation

1.1 Introduction

This workshop describes three types of data decimation: deleting duplicate points; creating a nautical chart, or binning; and filtering, a smart decimation tool. This includes creating nautical charts as well as data decimation. The files for this tutorial are in the "SHOALSToolbox1" directory.

1.2 Opening Data

To open the data file:

- Select *File* | *Open* and open "shoal1.pts" from the "SHOALSToolbox1" directory.

1.2.1 File Import Wizard – Step 1

This action opens the file import wizard dialog. The file import wizard allows the user to open any ASCII data file with the data in columns. To use the wizard:

- Leave the defaults as they are in the dialog. The file will be opened as a Scatter, or SHOALS set. Push the *Next* > button.

1.2.2 File Import Wizard – Step 2

The first line(s) in the *File preview* box are the file header. In this case, the file header consists of one line of data:

`SHOALS Sample File`

The next lines show the actual data. The data is shown so you can see the format of the file. In this case, the file has three columns of data. The first column is the Northing, the second column is the Easting, and the third column is the depth/bathymetry.

1. Switch the columns so that *X/Easting* is the 2nd column and *Y/Northing* is the 1st column. Keep the *Z/Depth* value as the 3rd column.

2. We will set some options for reading the data. Push the *Scatter Options* button.

   A SHOALS file consists of a group of points with bathymetric data. While a SHOALS file is opened, duplicate points are found and deleted. Duplicate points are points within a tolerance of other points. The default duplicate point tolerance is 0.00001. To change the tolerance:

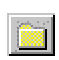
   a. Change the *Tolerance* in the bottom right of the dialog to “20.0” (ft – the default unit is feet). Push the *OK* button to exit this dialog. (Do not push *Next* > yet.)

Meta/Filter Options

Meta data files contain information about the origins of the SHOALS data as well as the coordinate system and the bounds of the data. To open a Meta data file:

1. Click on the *Meta/Filter Options* button at the bottom left of the *File Import Wizard* dialog.

2. Click on the *Import Meta Data File* button to turn it on.

3. Click the file button  and select “shoal1.met.”

The *Text preview* shows the text of the Meta data file. In this case, we are using an abbreviated Meta data file.

If a Meta data file contains coordinate system information, it is automatically updated inside of the SHOALS Toolbox (we will discuss coordinate systems later). The *Preview* window shows two polygons. The dashed blue line shows the bounding box of the data. The black polygon shows the boundary of the data as listed in the Meta data file.

This dialog also gives options for filtering the data as you read it. This is especially useful when you have a large file and you do not have enough computer memory to read the entire file. We will discuss filtering later.

1. Push *OK* to return to the wizard dialog.

2. Push the *Next* > button.

1.2.3 File Import Wizard – Step 3

This final step allows you to perform coordinate conversions. This will be used later.

- Push the *Finish* button.

The duplicate point check is one method of decimating the data as it is read into the SHOALS Toolbox.

The file shown in Figure 1-1 will be read into the SHOALS Toolbox. Notice that 2,222 duplicate points were deleted based on the tolerance of 20 that was entered. The module is automatically switched to the *Scatter Module* . Most of the editing and visualization of the SHOALS data will take place in this module.

Figure 1-1. Display of shoal1.pts.

1.3 Nautical Chart / Binning

Next, we will create a nautical chart. A nautical chart divides the data into bins and finds the points with the maximum and minimum depth in each bin. To start creating a nautical chart:

1. Make sure you are in the *Scatter* module .

2. Select *Scatter* | *Interpolate to Scatter…* and then *…to Nautical Grid*. A purple grid frame that bounds the data is created with a 10 % margin. The dialog shown in Figure 1-2 will also appear.

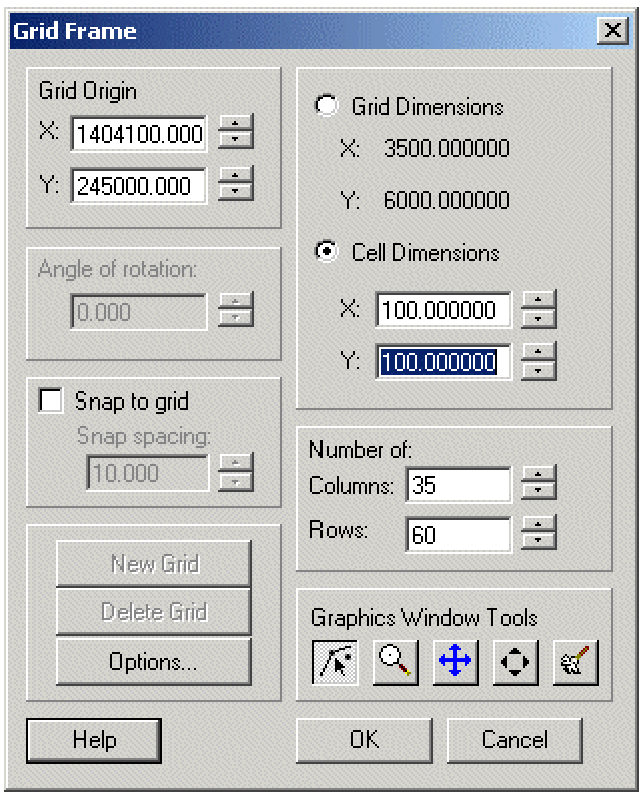


Figure 1-2. Grid Frame dialog.

You may specify either the grid dimensions or cell dimensions by clicking on the corresponding button. You can also resize and move the grid frame interactively on the screen. Select the black selection circles at the corners or edges to resize the grid frame. Click and hold the mouse down in the center of the frame to move the grid frame. We want to create a grid with cells 100 m x 100 m. To do this:

1. Click the *Cell Dimensions* button and set the dimensions and number of rows and columns as shown in the dialog above.

2. Move the frame on the screen until it bounds the data like Figure 1-3.

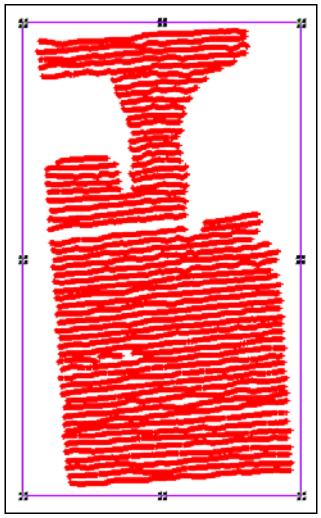


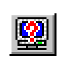
Figure 1-3. Grid frame around the data.

3. Push *OK* to create the nautical chart.

Three new sets of points are created, "Min," "Max," and "Avg." Three new points were created inside of each bin where the original set of data existed. To create the "Min" set, the minimum depth of the original set was found in each bin. A new point was created in each bin at the location of the minimum depth. The same process was done to create the "Max" scatter set. The "Avg" set is the average of the points in each bin, reported at the center of each bin. We will now see how to switch between the scatter sets and how to access the newly created data.

1.4 Multiple Scatter Sets

There are now three scatter sets in memory. Only one set is active (or visualized) at a time. The active set is drawn in its original color. All other sets are inactive and are drawn in a grayish-green color. To illustrate this:

1. Select *Display* | *Display Options...*  to bring up the display options dialog.

2. Click on "shoal1" in the window and push the *Make Active* button and push *OK*.

Notice that the new points are now displayed in the inactive color. A short cut to change active sets is provided using the *Edit Window* just below the menu. To change the active set to another set:

1. Click on the *Scatter* box in the *Edit Window* at the top (below the menus) that currently says "shoal1." Select "Min" to make it the active set.

We now want to look at the data in each bin. To do this:

1. Select *Display | Display Options...*  to bring up the display options dialog.

2. Select “shoal1” in the *Scatter* window and click the *Visible* checkbox. This turns the display of the “shoal1” set to off.

3. Select the other three sets, “Min,” “Max,” and “Avg” and make sure *Triangles* are off and *Points* are on.

4. Turn on the *Nautical Grid* button and push OK.

Zoom in on a region to see the data inside of the bins. Switch between “Min” and “Max” by changing the *Scatter* box in the *Edit Window*.

We will now delete the nautical chart. To do this:

1. Select *Scatter | Delete Scatter Set.*

2. Click the checkbox for the “Min,” “Max,” and “Avg” sets to select them for deletion and push *Delete*. Only the scatter sets that you select will be deleted. Push *Done* to exit the dialog.

3. Go into the *Display Options* and turn off the *Nautical Grid*.

1.5 Filtering Data

Redundant and overlapping data may exist in a SHOALS file. The user may remove unnecessary data points in relatively flat areas by filtering the data. The user specifies an angle. Each data point is checked to see if it is in a flat region by dotting the normals of the surrounding triangles (see Figure 1-4). If the normals are all within the specified angle, the region is flat and the point is deleted.

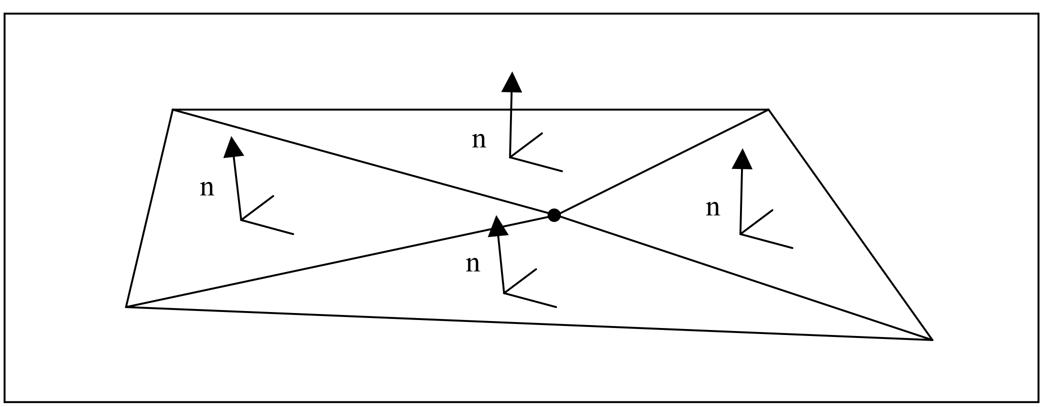


Figure 1-4. Normals for filtering.

In this section, we will create a regular grid over the data and interpolate to the grid. We will then filter the data several times. After each filtering, we will interpolate to the grid to compare errors.

1.5.1 Scatter Grid

To create the regular grid:

1. Select *Scatter* | *Interpolate to Scatter…* and then *…to Scatter Grid*. The same dialog used to create the nautical grid will appear.

2. Select the *Cell Dimensions* option and set the dimensions to 100 x 100. Set the *Number of Columns* to 31 and the *Number of Rows* to 58.

3. Set the *Angle of Rotation* to 4 degrees. The grid frame can also be rotated by selecting the black circle at the bottom right of the frame on the screen. This will align the grid with the data.

4. Make scatter set "shoal1" and data set "elevation" the *Scatter Set To Interpolate From* by highlighting "elevation" in the Data Set listing window.

5. In the *Other Options* portion of the dialog (bottom left) rename the *New data set name* from "grid_elevation_interp" to "Depth1." This will differentiate between data sets that will be created later.

6. Move the grid frame on the screen until it bounds the data and then push *OK* to create the grid.

A new scatterset, "Scatter_Grid," was created along with a data set "Depth1." The depths were interpolated to the grid. We will filter the data and then interpolate to the grid again.

1.5.2 Filtering

To filter the data:

1. Click the box *Scatter* in the *Edit Window* and change the active set to "shoal1."

2. Go to *Data* | *Filter...*

3. Set the *Filter Angle* to "5" (degrees) and push *OK*.

You will be told the number of points (~366) that were deleted. Push *OK* and you will be able to see holes in the areas where the bathymetry was relatively flat.

1.5.3 Interpolate to Scatter Grid

We will now interpolate the elevations to the scatter grid. To do this:

1. Make “Scatter_Grid” the active set.

2. Select *Scatter | Interpolate to Scatter…* and then *… from Other Scatter Set*. This option interpolates from one set to another.

3. Make scatter set “shoal1” and data set “elevation” the *Scatter Set To Interpolate From* by highlighting “elevation” in the Data Set listing window.

4. Rename the *New data set name* in the *Other Options* portion of the dialog box (bottom left) from “elevation_interp” to “Depth2.” Push *OK*.

5. Push *OK*.

There are now 2 data sets associated with the grid. The first data set, “Depth1,” shows the depths of the area before filtering. The second data set we just created shows the depths after one iteration of filtering. We will repeat the filtering 2 more times and then compare the results.

1.5.4 Filtering 10 and 20 Degrees

To filter at 10 degrees:

1. Repeat Section 1.5.2 (Filtering) but use 10 degrees rather than 5 degrees (be sure to switch the set back to “shoal1”).

2. Repeat Section 1.5.3 (Interpolate to Scatter Grid) but use the name “Depth3.”

To filter at 20 degrees, repeat steps 1 and 2 with 20 degrees (step 1) and “Depth4” (step 2).

NOTE: To see how many points are in the data set, select *File | Get Info* . The top portion of the dialog shows the total number of points and triangles. In the bottom, you can select a scatter set to see how many points and triangles are in each set. Push *Close* when you are done.

Note that filtering with a 5 degree tolerance eliminated 366 points (this number may vary depending on the triangles that you deleted in the last tutorial). This represents 9% of the points in the data set. By increasing the tolerance to 20 degrees, the data set is reduced to 1,546 points out of the original 4,059 points (38.1%). The percentage of points removed by filtering is controlled by the spacing of the data points and the bathymetry represented by the data points.

This exercise also illustrates another form of data decimation. The grid we created over the data set includes 1,888 points. The user, through specification of the grid parameters controls this number. In this case the reduction is almost 70%.

Before we can gauge the effectiveness of the filtering, we need to examine how much information was lost. This is done in the next two sections.

1.6 Data Browser

The four data sets you created, "Depth1," … "Depth4" contain the interpolated bathymetry after each step of filtering. The data sets all belong to the "Scatter_Grid" scatter set.

A data set is a set of values for each point. The elevation/depth value is the most common data set, and is the only data set that was created when the original SHOALS data file was read. When multiple data sets exist for a data set, one scalar and one vector data set are "active." The scalar data set includes the values that will be contoured. The vector data set includes the values that will be displayed with vector arrows.

- Make "Scatter_Grid" the active scatter set.

As you move your mouse around, the *X*, *Y,* and *Z* locations are updated in the bar below the *Graphics Window*. The *Z* value tracks the current data set along with the *S*, or scalar value. In the *Edit Window*, you will notice the *Scalar* box is set to "Depth1" and the *Vector* box is dimmed out. This indicates that the "Depth1" scalar data set is being displayed, and that the data set currently has no associated vector data sets to display.

To switch the active scalar data set:

1. Select the *Scalar* box in the *Edit Window* and switch it to "Depth2."

"Depth2" is now the active scalar data set. As you move the mouse over the data, the values reported below the Graphics Window now show the values from "Depth2."

Another way of switching the active data sets is through the data browser. The data browser allows you to import and export data sets and to view information about the data.

To access the data browser and set the active data set:

1. Go to *Data | Data Browser...*
2. Push the *Info*... button in the *Scalar Data Sets* section. The *Scalar Data Set Info* dialog that appears gives information about the active data set. The maximum and minimum values of the active data set are shown. You can

also change the name of the data set in the top edit box. Push *OK* to exit the dialog.

3. Push *Done* to exit.

1.7 Data Calculator

The final step involves comparing the results of filtering the data. We will use the data calculator to complete this step. The data calculator allows you to perform arithmetic operations with data sets. We will create 3 new data sets of the difference between the original depth and the three filtered depths. To open the data calculator:

1. Make sure “Scatter_Grid” is the active set.
2. Select *Data | Data Calculator*.
3. Enter “b” in the *Expression* area. Do this by:
   a. Double-clicking on the “b. Depth2” data set in the top window or
   b. Select “b. Depth2” and click *Add to Expression* or
   c. Type “b” in the *Expression* box.
4. Enter “-” in the *Expression* by typing “-” or clicking the “-” button in the dialog.
5. Enter “a” in the *Expression* in the same manner as step 3.
6. Rename the *Result* to “diff5” (difference of 5 degrees).
7. Push *Compute* to create the “diff5” data set.
8. Repeat the operation for creating data sets for “diff10” from “c-a” and “diff20” from “d-a” and push *Done* to exit the dialog.

Now select the “diff5” data set. Turn on contours if they are not on. The contour legend shows that the "error" or lost data varies from about -1 to 1 ft. The blue and red areas indicate areas of significant error. Drag the cursor over the grid to get an idea of the error in general.

To get a numerical feeling for the error, go into the Data Browser and view the information about the “diff5” data set. It shows that the range is -0.9 feet to 0.6 feet, the mean is 0.00052 feet, and the standard deviation is 0.073 (depending on your data).

To further illustrate the quality of the approximation, change the contour options.

1. Go into the display options and bring up the *Contour Options* dialog.
2. Change the *Contour Method* to *Color Fill.*
3. Select the *Contour between specified range* button.
4. Specify a range of -0.05 to 0.05.
5. Click *OK*.

Now the blue areas show where an area was raised more than 5/100 feet (0.6 inches) and the red areas show where an area was lowered more than 5/100 feet. Increase the range you are contouring to -0.1 to 0.1. The blue and red areas decrease as the range increases because we are increasing the tolerance. As long as the approximation is within allowable limits the data decimation is successful.

Repeat this process to examine the "error" in the “diff10” and “diff20” data sets.

1.8 Optional Exercise

Compute a data set that shows the error as a percentage of the depth for each of the three filtering values.

1.9 Conclusion

Data filtering can be accomplished by either interpolating to a regular grid, or eliminating relatively flat data points in the scatter set. Once a data set if filtered, the smaller, cleaner data set can be saved for future use.

The data calculator allows the user to evaluate the affect of the data decimation. It also has application to visualize the change between two data sets of the same area from one time to another.

This concludes the tutorial. If you wish to exit at this point:

- Choose *File* | *Exit*.

Workshop 2

Compute Change

2.1 Introduction

This workshop is a comprehensive tutorial that will cover much of what you have learned so far. You will open data from Eastpass near Destin, Florida. The first set of data is right after Hurricane Opal (October 1995) and the second set of data is a month later (November 1995). You will view the change in bathymetry and find the change in volume. The files for this tutorial will be in the "SHOALSToolbox2" directory.

2.2 Opening Files For Two Years

First open data for October 1995. To do this:

1. Start the program.
2. Select *File* | *Open* and select "oct95.pts."
3. Push *Next* > to skip to the second step.
4. Make sure *X/Easting* is set to the 1st column and *Y/Northing* is set to the 2nd column.

5. Push the *Scatter Options* button, set the *Tolerance* to 1.0, and push *OK*.

6. Push *Finish* to open the file.

Repeat the above steps to open “nov95.pts.” Set the coordinate system:

- Go to *Edit* | *Current Coordinates*... and make sure the horizontal and vertical systems are set to “Local” and set the horizontal and vertical units to “Meters.” (The coordinate systems are not as important as the units in this example. We need to set the units to measure volume and area.)

The first set will be called “oct95” and will be drawn in the inactive color of grayish-green. The second set will be called “nov95.” Make “oct95” the active set.

2.3 Deleting Extra Points

In this tutorial, we will compare the change in depth over a section of the data. We can delete extra points that won’t be used. We will delete the points using the *Map*  module. (The *Map* module is described in greater detail in the next tutorial.) To do this:

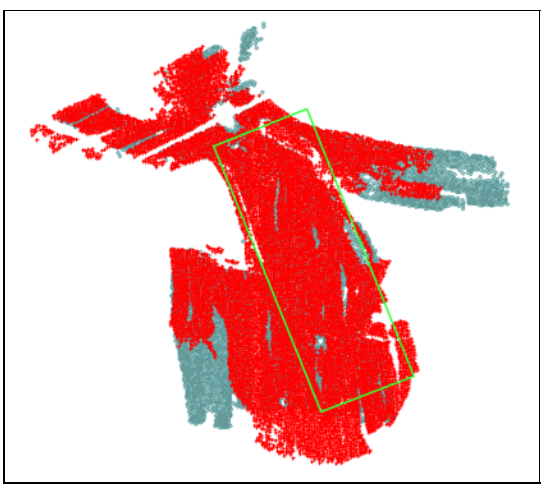
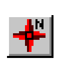
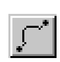


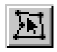
Figure 2-1. October and November data sets with area of interest.

1. Switch to the *Map*  module.

2. Select the *Create Feature Arc*  tool and create an arc around the box shown in Figure 2-1. Leave about a 10% margin around the box. Start by clicking on a corner and click on the other corners. As you create the arc, if you make a mistake and wish to back up, press the *BACKSPACE* key. If you

wish to abort the arc and start over, press the *ESC* key. Close the arc by double-clicking the last point on the first point.

3. Go to *Feature Objects* | *Build Polygons*. This creates a polygon in the closed loop you created with the arc.

4. Select the enclosed area of the arc (the polygon) by selecting the *Select Polygon*  tool and clicking inside the arc.

5. Go to *Feature Objects* | *Select/Delete Data...*

   a. Select the *Delete* option at the top of the dialog.

   b. In the *Scatter* section, push the *All Sets* button to select both scatter sets (an asterisk is placed next to each selected set).

   c. Select the *Outside Poly(s)* option in the *Delete Data* section.

6. Push *OK* to delete the data. After a few moments, the area should look like Figure 2-2.

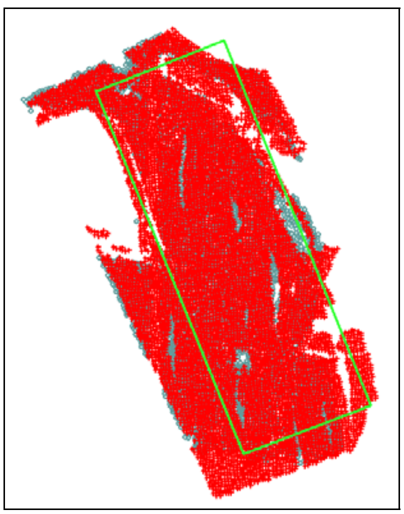


Figure 2-2. Data sets after point deletion.

2.4 Create Scatter Grid

To compare the two sets of data, you could interpolate from one scatter set to another or create a grid and interpolate both sets to the grid. We are only interested in a portion of the data, so we will create a grid and interpolate both sets to it. To do this:

1. Switch back to the *Scatter*  module and make "oct95" the active set.

2. Select *Scatter* | *Interpolate to Scatter...* and then *...to Scatter Grid*.

3. Create a grid with the origin at "1,334,750" X and "506,400" Y. Rotate the grid by "22" degrees and make the *Grid Dimensions* "2,000" X and "6,000" Y. Use "25" columns and "80" rows.

4. Select the "elevation" data set under "oct95" as the *Scatter Set To Interpolate From*.

5. In the *Other Options* portion of the dialog change the *New data set name* to "oct95."

6. Push *OK* to create the grid.

7. Select *Scatter | Interpolate to Scatter…* and then *…from Other Scatter Set* and select "elevation" under "nov95" as the *Scatter Set To Interpolate From*.

8. In the *Other Options* portion of the dialog , set the data set name as "nov95."

9. Push *OK* to perform the interpolation.

10. Turn off the other scatter sets (except for "Scatter_Grid") in the display options (*Display | Display Options…*) by selecting the sets and turning off the *Visible* button. Push *OK*.

The new scatter set now contains data for the two years.

2.5 Volume Change

The next step consists of finding the difference between the data sets to find the volume change. To do this:

1. Select *Data | Data Calculator*, enter "b-a" in the *Expression* area, enter "diff" as the *Result* name, and push *Compute*.

2. Push *Done* to exit the calculator.

The new data set "diff" has the change in depth between the two months of data. Use the *Select Triangle*  tool to select one or more triangles. The text on the bottom tells how many triangles were selected and the area and volume of the selected triangles.

You can also output the areas and volumes to a file. To do this:

1. Select *File | Info Options*.

2. Turn on *Echo to File* and select "echo.txt" as the file (push the file browser button to set the filename).

3. Turn on *Display Echo Window*.

4. Make sure *Distance*, *Area*, and *Volume* are turned on for the *File* option.

This dialog allows you to set what data is displayed under the *Graphics Window* (under *Screen*) and to a file and the echo window (under *File*).

5. Push *OK* to exit the dialog.

When you push *OK*, the *Selection Info* dialog (also called Echo Window) opens. Select several triangles. The information shown in the Selection Info dialog is also written to the "echo.txt" file you specified.

This option is useful for reporting volumes. You can copy from the *Selection Info* dialog or use the "echo.txt" file you generate. Remember to turn off the echo to file option when you are done, otherwise the file may become very large. Go ahead and turn off the option when you are done experimenting. Turn it off by clicking *Stop File Echo* in the *Selection Info* dialog and then close the dialog.

2.6 Gradient, Directional Derivative

Data sets will be generated automatically from the bathymetry from the active data set. To create the data sets:

1. Make "oct95" the active data set (select "oct95" in the top *Edit Window*).

2. Select *Data* | *Create Data Sets*...

   Two sections of data sets are listed. We are only interested in geometry so turn off the *Coastal* option. Four data sets are left.

3. Turn off *Grid Spacing*. *Grid Spacing* calculates the distance between points. Since we are using a grid, the distance is uniform.

4. Rename "Gradient" to "OctGradient," "Gradient_angle" to "OctGradient_angle" and "Direct_deriv" to" OctDirect_deriv."

5. Push *OK* to compute the data sets.

Repeat the steps and compute the data sets for the "nov95" data set (except rename "Gradient" to "NovGradient," etc). View the results by making each data set active and move the mouse over the data. Change the data set to "OctGradient" and "NovGradient." Turn on the contours and view the gradient to get an idea of the layout of the channel.

2.7 Exporting Data

The SHOALS export dialog allows you to save as many columns of data as you would like. We'll save the grid with the different years. To do this:

1. Make "Scatter_Grid" the active *Scatter Set*.

2. Go to *File* | *Save As*.

3. Change the *Save as type* to *Shoals Files*, enter the name "diff.pts," and push *Save*.

4. Enter an appropriate header such as "East Pass grid, Oct – Nov 1995 (# pts)."

5. Change the *Number of Columns* to "6."

6. Set *Column* 1 to be "Id." Set the other columns as: 2 = X, 3 = Y.

7. Set column 4 as "oct95 (Scalar)," column 5 as "nov95 (Scalar)," and column 6 as "diff (scalar)." (To get to column 6, use the down arrow on the scroll bar at the right of the *Column Headers*.)

8. Push *OK* to save the file.

NOTE: You didn't save Z in any column. The Z value for scatter points is the active scalar data set. In this case, "diff" is the active data set (it is selected in the *Edit Window* under *Scalar*).

2.8 Conclusion

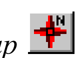
This concludes the tutorial. If you wish to exit at this point:

- Choose *File* | *Exit*.

Workshop 3

Coastlines and Profiles

3.1 Introduction

In this tutorial, you will learn some functionality of the *Map*  module. For this tutorial, we will use data in the folder "SHOALSToolbox3."

For this tutorial, we will use a set of data from Shinnecock Bay. After opening the file, we will create a contour at the 0.0 depth in order to see where the coastline will go. Open the file:

1. Start the program.

2. Select *File* | *Open...* and select "beach.pts."

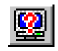
3. Skip to the second step and click the *Scatter Options* button. Change the tolerance to 1.0 and push *OK*.

4. Still in the second step, make sure the *X/Easting* is set to the 1st column and *Y/Northing* is set to the 2nd column.

5. Push *Finish* to open the file.

After opening the data, we need to set the current coordinates and display options:

1. Go to *Edit* | *Current Coordinates*... and set the *Horizontal Datum* to "Local," "U.S. Survey Feet" and the *Vertical Datum* to "Local," "U.S. Survey Feet." (The coordinate systems are not as important as the units in this example).

2. Go to *Display* | *Display Options*...  and make sure the scatter points are on.

3. Turn the *Contours* on and go to the *Contours* tab. Select *Normal Linear*. Select *Specified values* and click the *Values*... button. Enter 0.0 in the first cell and push *OK*.

4. Change the *Line thickness* to 3 (still in the contour options dialog).

5. Select the *Color Options*... button and select *Hue Ramp*. Push *OK* two times to get out of the dialogs.

A contour is drawn at the 0.0 depth to show where the coastline will go (Figure 3-1).

Figure 3-1. Data with contour at 0.0 depth.

3.2 Using Feature Objects

With a background data set, the conceptual model can be created. A conceptual model is constructed using *feature objects* in the *Map* module. Feature objects include points, nodes, arcs, and polygons, as shown in Figure 3-2. Feature objects are grouped into sets called *coverages*. Each coverage represents a particular type of data, but only one coverage is active at a time.

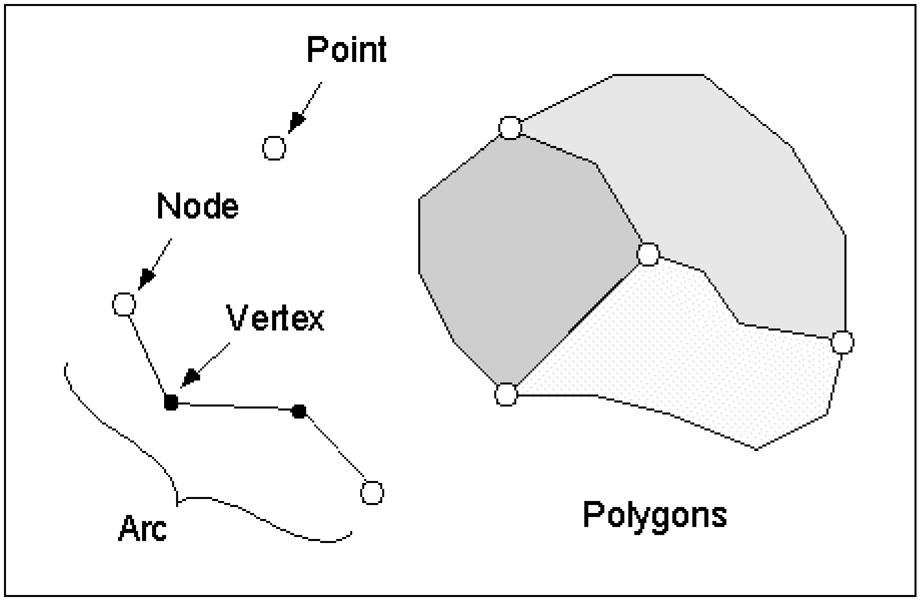


Figure 3-2. Feature Objects.

A *feature point* defines an (x, y) location that is not attached to an arc. A *feature node* is the same as a feature point, except that it is attached to at least one arc.

A *feature arc* is a sequence of line segments grouped together as a polyline entity. Arcs can form polygons or represent linear features such as coastlines. The two end points of an arc are called *feature nodes* and the intermediate points are called *feature vertices*.

A *feature polygon* is defined by a closed loop of feature arcs. A feature polygon can consist of a single feature arc or multiple feature arcs, as long as a closed loop is formed.

The conceptual model in this example will consist of a single coverage, in which the coastline and profiles will be defined. As you go along in this tutorial you will load new coverages over the existing coverage. The new coverage will become active and the old coverage will be inactive.

3.3 Coastline Arcs

A set of feature objects can be created to show important features such as coastlines and profiles. Feature objects can be digitized inside the toolbox, they can be converted from an existing *AutoCAD DXF* file, they can be created from coastline files, or they can be created using a few automated procedures.

3.3.1 Creating the Coastline

We will start by creating a coastline. To create the coastline:

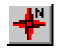
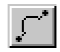
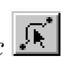
1. Switch to the *Map*  module.
2. Choose the *Create Feature Arc*  tool from the *Toolbox*.
3. Click along the coastline as shown in Figure 3-3. As you create the arc, if you make a mistake and wish to back up, press the *BACKSPACE* key. If you wish to abort the arc and start over, press the *ESC* key. Double-click the last point to end the arc.

Figure 3-3. Arcs created over contour.

After you create each arc, the arc becomes blue. This indicates that it is a profile (or cross section). To change it to a coastline:

1. Select the *Select Feature Arc*  tool and double-click on the new arc.
2. In the *Shoals Arc Atts* dialog, change the type to *Coastline*.

The arc now becomes brown, indicating that it represents a coastline.

This is one way to create a coastline. A second way is to generate the coastline automatically at a specified depth. To do this:

1. Delete the old arcs by selecting the *Select Feature Arc*  tool and select both of the arcs you just created. Either click on the screen and draw a box around both arcs or select one arc by clicking on it and click the other arc while holding the SHIFT key.
2. Select *Feature Objects | Create Coastline* to bring up the *Create Contour Arcs* dialog.

3. Enter "0.0" as the *Elevation* (or depth), "150.0" as the *Spacing*, and click *OK*.

The two coastline arcs are generated automatically with a spacing of 150 ft.

3.4 Creating Profile Arcs

3.4.1 Display Options

The next step is to create feature arcs out into the ocean that show the beach profile. Profile arcs are generated automatically from coastline arcs and from the SHOALS data. First, set the SHOALS contours back by:

1. Switch to the *Scatter* module.
2. Go to the *Display Options* and turn the *Points* off.
3. Click the *Contours* tab. Switch the *Contour Interval* from *Specified values* to *Number of intervals* and set the intervals to 20.
4. Change the *Line thickness* back to 1 and make sure the *Contour between specified range* option is off.
5. Push *OK* to get out of the display options.

We will now create profile arcs off of the coastline arc.

3.4.2 Automatic Generation

To create the profile arcs automatically:

1. Switch to the *Map* module.
2. Select the *Select Feature Vertex* tool and select a few vertices along the left arc. Hold the SHIFT key down and click on the vertices to select several vertices (see Figure 3-4).
3. Select *Feature Objects* | *Create Profiles*...

A dialog will appear where you can enter a location (x,y) and an azimuth and profiles will be created. By default, if you have anything selected, the (x,y) location of the selected entities will appear in the dialog. The azimuth in this case is perpendicular away from the coastline arc.

4. Change the *Num. Segments* to "50" and the *Segment Spacing* to "40.0" (ft) for each profile in the dialog.

5. Check the *Extract Opposite Direction* checkbox for each profile. Unchecked, a profile will be created at the specified azimuth. Checked will create a profile at the specified azimuth and in the exact opposite direction (180° plus the azimuth).

6. Push *OK* to create the profiles.

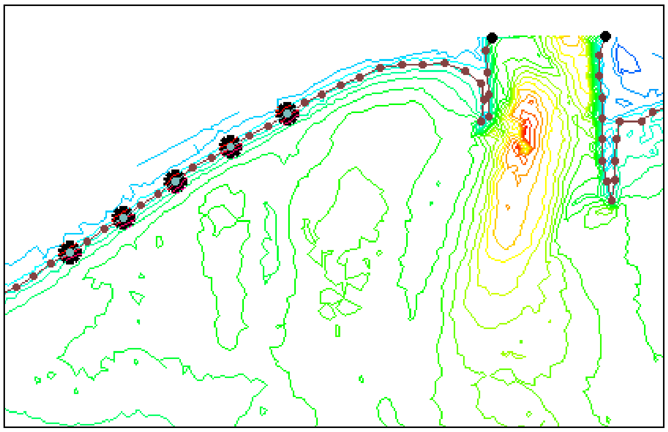


Figure 3-4. Selected vertices.

Blue profile arcs are created perpendicular to the coastline arc. The profiles shoot onto the land until the data ends and out into the ocean for 2000 feet (40 ft * 50 segments). Depth values are assigned to the vertices and nodes on the profile arcs.

3.4.3 Manual Generation

A profile arc can be created manually from the coastline arc. Manually creating the arc allows you to place the profile where you want it (if you wanted to click the arc out by hand rather than specify a location and azimuth). To do this:

1. Select the *Create Feature Arc*  tool.

2. Click somewhere on the coastline and create an arc into the ocean about the same length as the other blue profiles. Do this by clicking for each vertex and double-click to end the arc.

Figure 3-5 shows the final profiles.

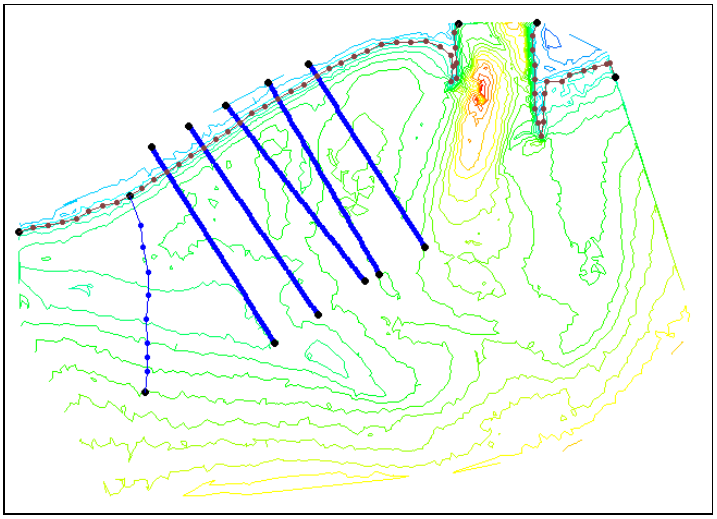


Figure 3-5. Manually created arc.

3.5 Profile Plots

Plots are created from each of the profiles. To view the plots:

1. Select *Display* | *SHOALS Plots* .

A list of the profile curves that you created are shown in the top left window. The options in the dialog include:

- List of curves:
    - Check boxes: Turn on/off to turn curves on/off in the plot window to the right.
    - Station: Select a station to see its origin and azimuth.
    - Curve: Select a curve to view and edit its distance/elevation points in the spreadsheet.
    - Right mouse: Right-click in the list window to see a menu of options.
- Create Arc At Origin: Create an arc at the specified location and azimuth. If you import profiles that are not geo-referenced, you can specify the origin here to geo-reference them.
- Plot Window: Right-click on the plot window to see options for the display in the window.

- Options: Click this button to open options for interpolating to new profiles. You can also set the *Water Surface Elevation*, which is the blue dotted line in the plot window.

- Import/Export: Import and export profiles in several file formats.

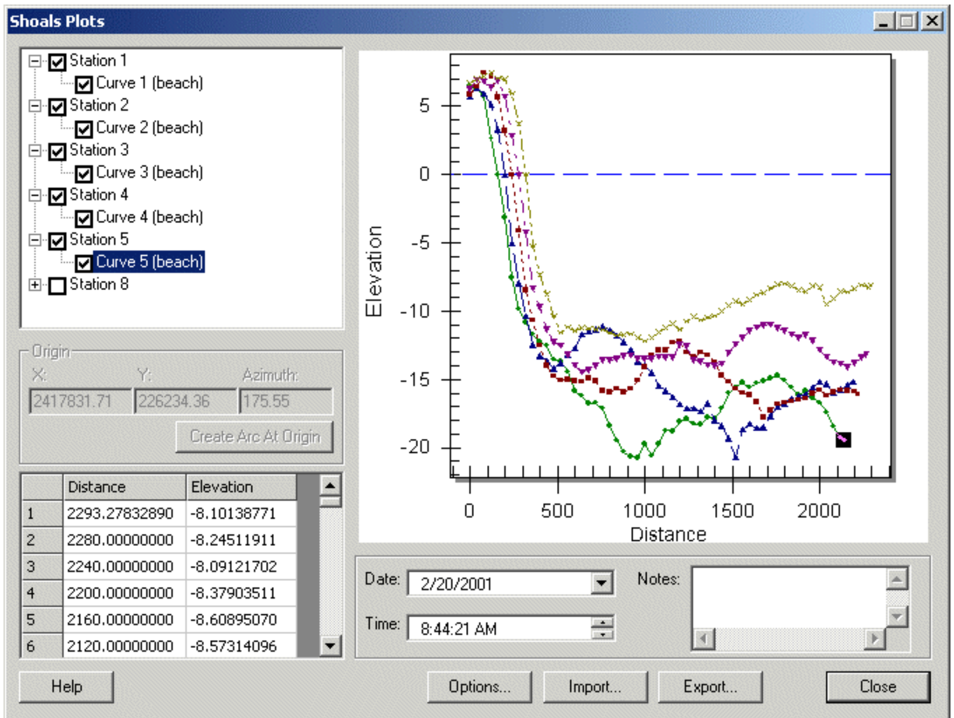


Figure 3-6. Shoals plots dialog.

You can leave this dialog up and repeat the steps above to create more profiles in the main screen. Play around with the options and create and delete more profiles.

3.6 Conclusion

This concludes the tutorial. If you wish to exit at this point:

- Choose *File* | *Exit*.

Workshop 4

Overview Exercise

4.1 Introduction

In this overview exercise, you will use each of the commands you have learned thus far to perform several tasks. This exercise will list only partial instructions for each step of each task. For more detailed instruction on each SHOALS Toolbox command, please refer to earlier tutorials. For this overview exercise, we will use data in the folder "SHOALSToolbox4."

4.2 File Preparation

For this tutorial, we will again use data from East Pass. Open the file:

1. Start SHOALS Toolbox.

2. Open files "Oct95.pts" and "Nov95.pts." Note the format for these files:

"Oct95.pts"	Easting Northing Elevation	(all in meters)
	horizontal datum	UTM, NAD 1983, Zone 16
	vertical datum	NAVD88
"Nov95.pts"	Northing Easting Elevation	(all in feet)
	horizontal datum	State Plane, NAD 1983, FL-N Zone
	vertical datum	NGVD29

Because the horizontal datums differ, the data sets appear in different locations in our geographic space.

If you zoom in on the data sets, you may notice that the orientations differ. This is due to the difference in file format—“Oct95.pts” has easting listed first while “Nov95.pts” has northing listed first.

To make a meaningful comparison between data sets, we must make the datums and orientation the same for all files. In the next few steps you will convert the easting, northing, and elevation values in “Nov.pts” so that they correspond to the same datums as “Oct95.pts.” To do this:

3. Select *File|Delete all*.

4. Open the data file “Nov95.pts.” Be sure to change the column specifications for easting and northing when you import.

5. Using the coordinate conversion tool, convert the horizontal datum to UTM83, Zone 16, in meters.

6. Using the data calculator, convert the vertical datum to NAVD88 based on the bar graph in Figure 7-1. This figure indicates that an elevation of 1.00 meters NGVD29 will have an elevation of 0.85 meters NAVD88. In addition, a negative elevation, or depth, of –1.00 meters NGVD29 will have an elevation of –1.85 meters NAVD88. You may want to name the new function NAVD88 to remind you of its reference datum.

7. Save the converted data to a new file. Be sure to specify the NAVD88 function for the Z value.

8. Exit SHOALS Toolbox.

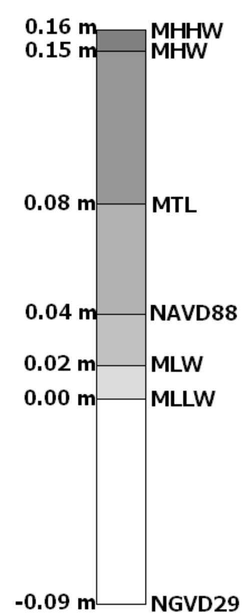


Figure 4-1 Datum elevations relative to MLLW at East Pass, Florida (Based on NOAA Benchmark sheets and NGS Data Sheets).

4.3 Data Set Comparison

Now we will compare the elevations from the October 1995 data set with those of the November 1995 data set.

1. Open your new data file and the data file "Oct95.pts." The scatter sets should overlap.

2. Remove all unreasonable triangles using *Triangles|check long triangles* and/or using the *triangle selection* tool. You may want to turn on the contours using the *Display options* to facilitate this process.

3. Use *Scatter|Interpolate to scatter* to interpolate values from the Nov95 scatter set to the Oct95 scatter set. This may take a few moments.

   You may want to name the new data set Nov95 so you can distinguish it from the Oct95 elevation function.

   This interpolation will give each x,y position in the Oct95 data set an elevation value based on the Nov95 tin surface.

4. Create a difference function between the data sets using the *data calculator*.

   This difference will give each x,y position in the Oct95 data set a value that is the difference between the Oct95 and Nov95 data sets.

   If you subtract the less recent data set (Oct95) from the more recent data set (Nov95), a negative difference will indicate erosion and a positive difference will indicate accretion.

5. Change the contour options (contour interval, contour range, etc.) to see the elevation differences calculated between the two surveys (see Figure 7-2 for an example).

6. Save your project.

4.4 Volume Computation

We will now compute the change in sand volume from October 1995 to November 1995 in the navigation channel, using the differences we calculated in the previous section. First we must draw the navigation channel alignment. To do this:

1. Draw an arc that defines the navigation channel. Refer again to Figure 7-2 for guidance.

2. To compute the volume of sand in the navigation channel go to the *Scatter* module and select all of the triangles in the navigation channel alignment

box. The volume is reported in the status bar. The cumulative change in sand volume in the navigation channel is the number in parentheses.

3. Save your project and exit SHOALS Toolbox.

4.5 Cutting Profiles Through SHOALS Data Sets

First, we will create profiles from SHOALS data where conventional beach profiles have been established. We need to bring in the historical profiles. To do this:

1. Open the profile file "mar96.prf." The profiles were collected by the Florida Department of Environmental Protection as part of a general beach condition survey of the state of Florida.

2. The horizontal datum for the profiles is State Plane, NAD27, Florida North Zone, in feet. The vertical datum is NGVD29, in feet. Use the *coordinate conversion* tool to convert the profiles to UTM, NAD83, Zone 16 meters and NAVD88 meters.

3. From the *Map* module, create a scatter set from the historic profile data.

4. Go to the *profile tool*. The profiles displayed are the imported profiles. Note

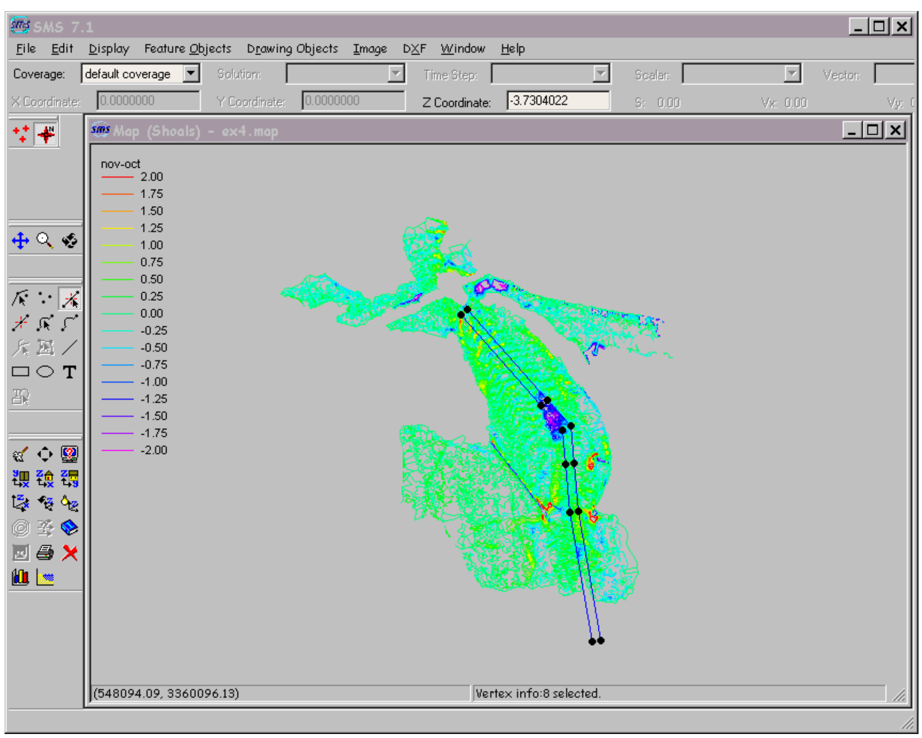


Figure 4-2 Contours of Nov95-Oct95 difference function and federal channel alignment.

that the units are feet.

5. In the *profile tool*, delete all profiles by right-clicking and selecting *"Delete all."*

6. Now open the two SHOALS data sets named "Feb00.pts" and "Jun00.pts." These data sets were collected by the US Army Corps of Engineers Mobile District as part of a regional shoreline survey for the Regional Sediment Management Demonstration Program in February and June 2000.

7. In the *Scatter* module, delete unreasonable triangles.

8. In the *Map* module, extract elevations for all arcs and all scatter sets.

9. Use the profile tool to view the profiles. Note the position of the offshore bar in each data set.

10. In the *Scatter* module, use the *display options* to view contours of the SHOALS data. The contours show the alongshore structure of the bars.

To create profiles between the historic profiles within SHOALS Toolbox:

1. Make several arcs that extend through the SHOALS data sets.

2. Select all of the new arcs. Go to *Feature objects|Redistribute vertices* and specify spacing along the profile. Choose *All scatter sets* and *Selected arcs* in the dialog that appears.

3. Use the *profile* tool to view the new profiles.

4. If you wish, save this project under a new file name and exit SHOALS Toolbox.